PART III

Physical Description

Physical Regions of Washington

On the basis of surface features, Washington may be divided into eight general regions. Agricultural settlement is influenced by factors of topography, climate, soil, forest vegetation and water resources distinctive to each of the physiographic regions. Each has become a different type of farming area as settlers have learned to adapt crops and livestock to the conditions, or have improved limitations through drainage or irrigation.

Coastal Plains

A narrow, sandy plain with shallow bays, tidal flats, stream deltas, and low headlands lies between the coastline and the Coast Range. It extends from the Columbia River mouth almost to Cape Flattery, being widest and lowest in the Grays Harbor and Willapa Bay districts. The climate is mild and damp with a long growing season, but it is too cool, cloudy and wet for most crops. Originally this area was covered with heavy forests and much is now covered with woodlands. Lumbering and manufacture of wood products is the main industry. Farming is largely of the livestock and dairying type on low uplands and drained areas in the lower Chehalis River Valley. Cranberry growing is important and well-adapted to numerous, boggy areas in the Grays Harbor and Willapa Bay sections. The shallow bays are also used for oyster culture. Fishing is common in the rivers and coastal banks.

Coast Range

The Coast Range is an uplifted area of sedimentary and metamorphic rocks divided into the Olympic Mountains and the Willapa Hills. The Olympics tower to nearly 8,000 feet in a dome-like structure, carved deeply by rivers. These mountains have the heaviest precipitation in the state. Snowfields and heavy forest cover the mountains. Most of the wilderness area is within the Olympic National Forest and Olympic National Park, being managed for recreation, wildlife and timber. Farm settlement is limited to some foothill river plains and coastal terraces such as the Dungeness and Port Angeles districts along the Strait of Juan De Fuca. Here in the lee of the mountains, rainfall is moderate and irrigation is practiced by some livestock farmers. The Willapa Hill country is wet, heavily forested and carved into numerous narrow valleys. Logging is the main industry, combined with livestock farming in the upper Chehalis River Valley and along the banks of the Columbia River. Wet climate, hilly topography and the difficulty of clearing stump land retards agriculture.

Willamette-Puget Sound Lowland

A broad lowland, described as a trough or valley, lies between the Coast Range and the Cascade Mountains. The northern part is the Puget Sound Lowland which has been glaciated and occupied by the sea in the lowest section. The continental glacier reached slightly south of Olympia. Under a warming climate it melted and geologists believe it receded about 25,000 years ago, leaving an infertile plain of moraines and outwash gravels, sands and clays known today

as the Puget Glacial Drift Plain. Its rolling surface has numerous lakes and bogs. Most of the major cities--Seattle, Tacoma, Everett, Bellingham and Olympia--have been built on moraines bordering the Sound. Rivers, such as the Nooksack, Skagit, Snoqualmie, White and Puyallup, built up deltas and flood plains over the older gravelly plains. These narrow valleys are more fertile than the older glacial plains, and support numerous small dairy, vegetable and berry farms Most of the gravelly areas are wooded with a second-growth forest and are used for pastures. In the southern part of the Willamette-Puget Sound Lowland, there are two large valleys--the Cowlitz and Chehalis. They drain a low, hilly area with several flat prairies and bottom lands.

Agriculture is handicapped by poor drainage and flooding of the river deltas and plains, by heavy winter rainfall, by cloudy but dry summers, by coarse, gravelly upland soils and by densely wooded land which is costly to clear. Advantages are mild climate and a location close to major markets for farm products such as milk, poultry and vegetables.

Cascade Mountains

The Cascades are a wide and high topographic and climatic barrier which separates western and eastern Washington. The range is made up of sedimentary, igneous and metamorphic rocks which have been carved by glaciers and streams. High isolated volcanic cones of lava such as Mt. Adams (12,307 feet), Mt. Rainier (14,408 feet) and Mt. Baker (10,791 feet) appear upon the older Cascade rocks. The Cascade crest varies between 10,000 and 3,000 feet and is higher and more rugged in northern Washington. Roads and railroads have been built across its lower passes in central and southern Washington. The Columbia River has cut a deep gorge and the lowest pass through the barrier. The western slope is wet and heavily forested with Douglas fir. The eastern slope is drier with a less-dense pine forest. Nearly all classified as forest land, most of the area is in Federal ownership in five national forests and Mount Rainier National Park. Tree fruit farming in the eastern slope valleys of Wenatchee, Chelan, Methow, Naches and the Columbia Gorge is most important. Sheep and cattle summer grazing on alpine grasslands is another use. Deep western slope valley bottoms such as the Skagit, Snoqualmie, Nisqually, Cowlitz and Lewis also contain livestock farms. The area is vitally important as a source of water for irrigation and city drinking water and as a source of timber. Steep terrain, wet climate, short growing seasons and heavy forest vegetation are main handicaps for agriculture.

Columbia Basin

A low plateau of old lava rocks covered with stream and wind-deposited soils extends in a series of plains, ridges, coulees and hills from the Cascades to the eastern Washington border. The area is basin-like in structure, being higher around its margins and sloping inward to low and level central plains. It has been sharply eroded by the Columbia River and its interior tributaries, the Snake, Yakima, Palouse and Spokane Rivers. The basin has sub-areas created by crustal movements and erosion.

The Yakima Folds are a series of hilly ridges extending from the Cascades eastward into the lower part of the basin. The Yakima and Columbia Rivers have cut gaps through the ridges and built up plains in the troughs between them. The rich, alluvial plain of the Yakima River is an important irrigated valley.

The Waterville Plateau is a tableland of thin soils overlaying basaltic rock at an elevation of 2,500 to 3,000 feet. It has gorges cut by the Columbia River and ancient glacial outwash streams once flowing in Moses and Grand Coulees. It is too high for irrigation and is used for dryland grain and livestock farming. The high plain is often called the Big Bend country.

The Channelled Scablands is a belt of dry terrain carved by ice-age rivers into a series of coulees. Bare rock is exposed in the coulees. Small plateaus between the old river channels have thin soils used for dryland farming. The Grand Coulee of this region has been developed into a major irrigation reservoir.

The Palouse Hills consist of fertile deposits of wind-blown soil overlaying basaltic lava flows. After being deposited in large dunes, the formation was reshaped by streams into an intricate pattern of low, rounded hills which are tilled for wheat, barley and legumes. The hills receive 16 to 25 inches of rainfall and have deep, porous and fertile soils. It is one of the richest farming areas of the Pacific Northwest.

The Central Plains are low and relatively level expanses of soil, deposited by old streams crossing the Channelled Scablands and later by the flooding of the Yakima, Columbia, Snake and Walla Walla Rivers. Climate is desert-like (6-12 inches of precipitation per year). The lower lands of the area, the Quincy and Pasco Basins and the Walla Walla Valley, are irrigated. Quincy Basin is a new irrigation area watered by Grand Coulee Dam.

Agricultural handicaps in Columbia Basin regions are mainly found in its dry, continental climate. Large irrigation systems built since 1900 have overcome much of the need for water on rich valley and basin soils. Dryland farming in higher areas is practiced widely, although occasional variations in rainfall, lack of snowfall, winter-kill, water and wind erosion inflict damage to field crops and to livestock ranges.

Okanogan Highlands

A portion of the Rocky Mountains, consisting of well-eroded old granites, lavas and sedimentary rocks extends across north central Washington. These are the Okanogan Highlands, the state's richest mineral area. Summit levels reach 4,000 to 5,000 feet with peaks exceeding 7,000 feet. Prominent north-south valleys are occupied by irrigated tree fruit and livestock farms. These are the Okanogan, Sanpoil, Kettle and Colville Valleys. The Columbia River gorge through the Okanogan Highlands is occupied by the large man-made lake behind Grand Coulee Dam--Roosevelt Lake. High and wetter portions are forested with pine and larch, and are managed for timber and for livestock ranges by the United States Forest Service and the Bureau of Indian Affairs. Cold winter temperatures, short growing seasons, dry valley climates and distance from markets are farming handicaps.

Selkirk Mountains

The Selkirks, a range of the Rocky Mountain system, extend into the northeast corner of Washington. The rocks are old mineralized granites and metamorphics reaching elevations of over 7,000 feet. The Pend Oreille River Valley

at the base of the Selkirks is an agricultural area of narrow bottom lands settled by livestock farmers. Nearly all of the uplands are in Kaniksu National Forest. While climate is cool and growing seasons are short, the Pend Oreille Valley has an advantage of being closely located to the Spokane metropolitan market area.

Blue Mountains

The Blue Mountains are an uplifted and eroded plateau extending into the southeastern corner of Washington. The strata are mainly ancient crystalline rocks which contain some minerals. The highest point of the mountains in the Washington section is Diamond Peak (6,401 feet), on the divide between the Grande Ronde, Tucannon and Touchet Rivers. These rivers, and the Walla Walla River, have cut valleys into the plateau. Extensive pine forest and grassland areas are in the highlands within Umatilla National Forest, where rainfall is 30 to 40 inches. The Snake River has cut a deep valley and gorge across the lower parts of the mountains. The area is well developed agriculturally around its northern foothills where wind-blown soils are deep and irrigation systems are used. The Walla Walla and Tucannon Valleys are rich grain, legume and livestock areas grown under irrigation and by dry farming. Grazing is an important use of the high lands by livestock ranchers in the upper valleys.

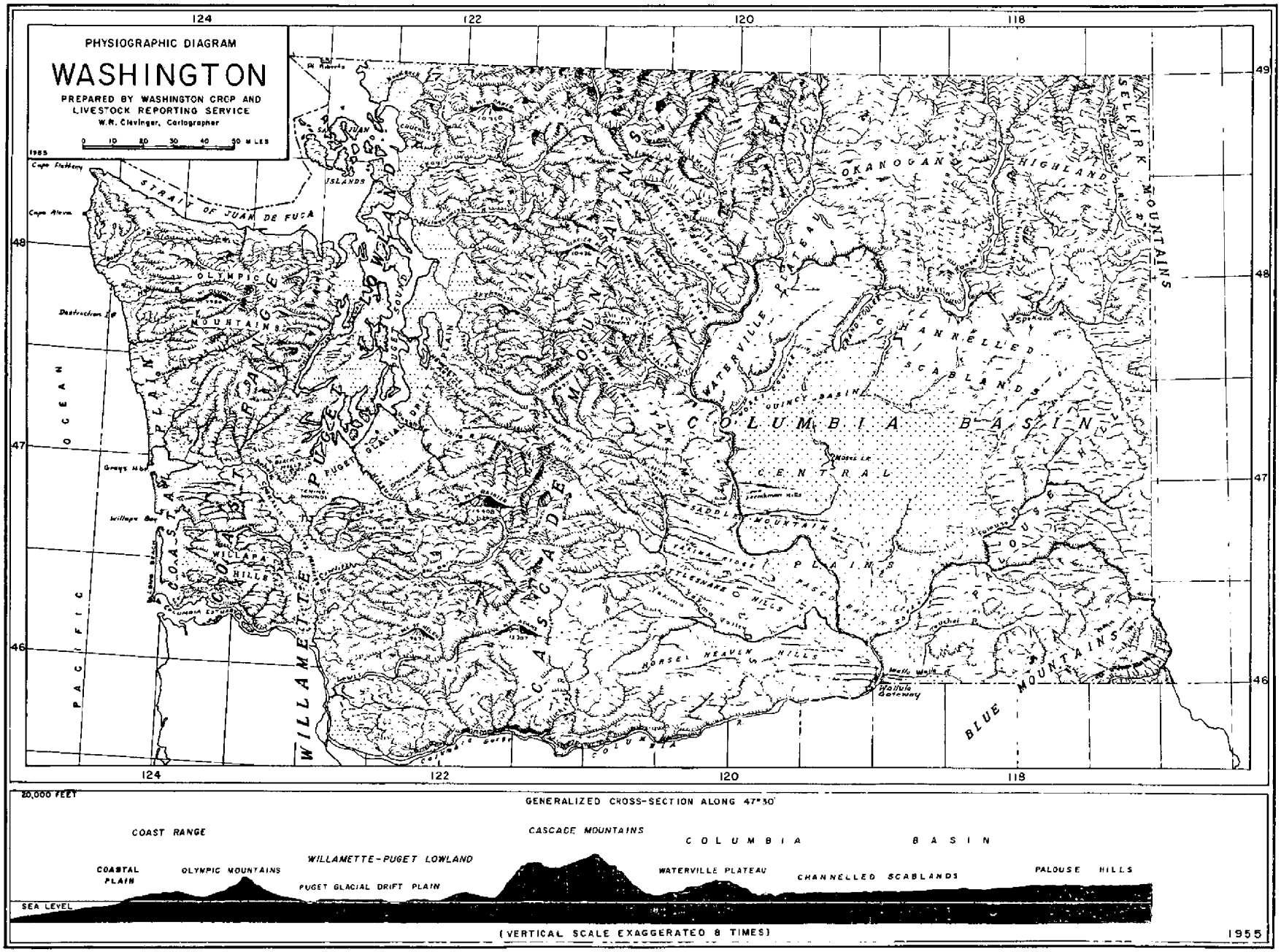
Topography of Kitsap County

Most of Kitsap County is a maritime land moderately low in elevation, being located in the center of the glacial drift plain known as the Puget Sound Lowland. It is a peninsula nearly surrounded by Hood Canal and Puget Sound. A small, rough, broken, mountainous area, called Green Mountain and the Blue Hills near Bremerton, is the highest area. This localized upland reaches 2,500 feet on the Green Mountain ridge. Most of the Kitsap Peninsula is made up of gently sloping moraines, narrow stream valleys, and Puget Sound shore bluffs. The underlying materials are deep deposits of gravels, sands and clays. According to geologists they were deposited by the receding glacial Puget ice sheet of the Pleistocene over 10,000 years ago. From an agricultural standpoint the most important topographic features are the gently sloping glacial plains and the table land or low plateau of Bainbridge Island.

Numerous small streams, ponds, bogs and lakes are distributed over the Kitsap Peninsula and Bainbridge Island. Puget Sound inlets indent the peninsula in many places with shallow, calm stretches of sea water. The water bodies give scenic beauty to the landscape and provide many havens for boats and ships as well as good residential sites. Most of the county's population lives on the shores and bluffs near tidewater. Nearly all farms are within five miles of the shores of Puget Sound or Hood Canal. The Hood Canal inlet to the west and the Puget Sound strait to the east, however, have long isolated the peninsula area from rapid railroad and highway transportation to the mainland trade. The area's development is dependent on cross-Sound bridging and ferrying to lessen its peninsular isolation. Most of the population lives along the shoreline lands in the northern part of the peninsula.

Land Classification and Soils

In general, the wide and deep deposition of rocky material by earlier glacial action, followed by forest growth have not resulted in a favorable top


PHYSIOGRAPHIC DIAGRAM
WASHINGTON
PREPARED BY WASHINGTON CROP AND LIVESTOCK REPORTING SERVICE
W.R. Clevinger, Cartographer
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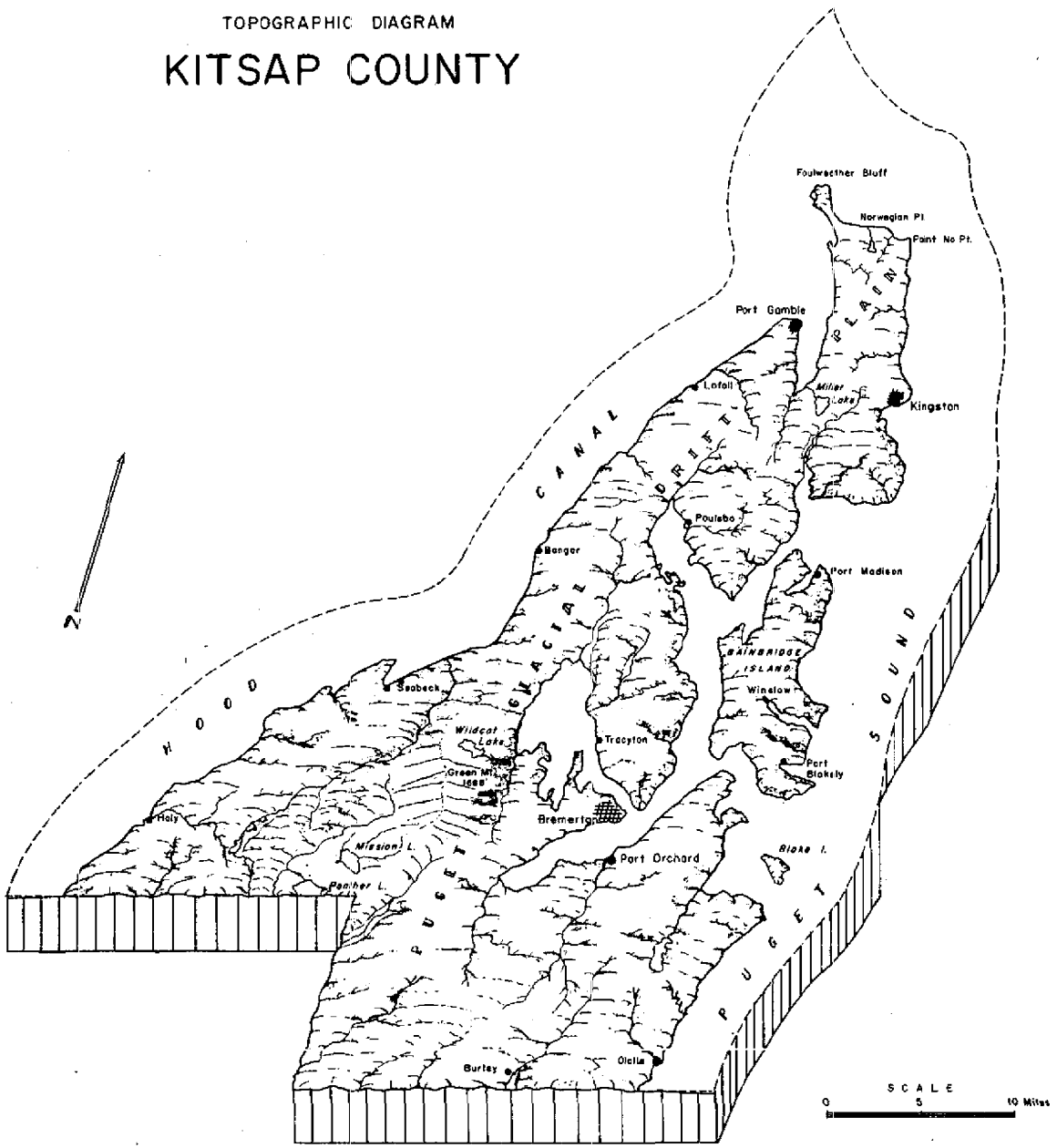
PACIFIC OCEAN
STRAIT OF JUAN DE FUCA
SAN JUAN ISLANDS
OLYMPIC MOUNTAINS
COAST RANGE
PUGET SOUND
PUGET GLACIAL DRIFT PLAIN
WILLAPA HILLS
WILLAMETTE VALLEY
CASCADE MOUNTAINS
OKANOGAN HIGHLANDS
SELKIRK MOUNTAINS
WATERVILLE PLATEAU
CHANNELLED SCABLANDS
QUINCY BASIN
COLUMBIA BASIN
CENTRAL
SADDLE MOUNTAINS
PALOUSE HILLS
PASCO BASIN
YAKIMA RIDGE
RATTLESNAKE HILLS
HORSE HEAVEN HILLS
BLUE MOUNTAINS
COLUMBIA
GENERALIZED CROSS-SECTION ALONG 47°30'
20,000 FEET
COAST RANGE
CASCADE MOUNTAINS
COLUMBIA BASIN
COASTAL PLAIN
OLYMPIC MOUNTAINS
WILLAMETTE-PUGET LOWLAND
PUGET GLACIAL DRIFT PLAIN
WATERVILLE PLATEAU
CHANNELLED SCABLANDS
PALOUSE HILLS
SEA LEVEL
(VERTICAL SCALE EXAGGERATED 8 TIMES)
1955

TOPOGRAPHIC DIAGRAM

KITSAP COUNTY



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soil for agriculture in the greater part of Kitsap County. Soils vary sharply in type on farms and in small localities. Productive land is limited to small alluvial valleys, drained lake beds and level plains of fine, sandy and gravelly glacial soils. Since the glacial period, forest growth, stream deposits of silts, lake deposits of peats and man-made improvements have made the coarse glacial material more arable and fertile for crops and pastures. Main soil deficiencies are the lack of soluble minerals such as lime, phosphorous and nitrogenous organic matter, and the coarseness of the gravelly subsoils which causes rainfall and soil moisture to drain off too rapidly during the wet season and the summer growing season.

The land is divided into three general classes, ranging from good to poor for farming to steep, rocky, hilly areas suited only for forests. 1/ The first soil survey in 1939 mapped a large variety of glacial and sedimentary soils consisting of 31 types. 2/

The best lands and soils of Kitsap County are Class III, typed as moderately good land. They are located in the narrow Burley Creek, Minter Creek and Blackjack Creek valleys south of Port Orchard, in the lowlands from Poulsbo to Lofall, and generally over the surface of Bainbridge Island. The most productive soils in these localities are the Kitsap loam soils on the stream benches, bands of alluvial soils along Minter Creek and Burley Creek and the Muck soils along Blackjack Creek, all these valleys being between Port Orchard and Burley in southeast Kitsap County.

In north Kitsap County the Class III lands about Poulsbo, Lofall, Port Gamble, Kingston and Port Madison are sloping glacial soils which are of fair productivity when sprinkler irrigated and fertilized with manures and chemical fertilizers. Most important of the soils are the Alderwood loams which vary in texture between sandy and fine sandy loams. Other glacial soils of the north are the Everett and Indianola loams which are loose sands and gravels and are excessively droughty.

The Kitsap silt loam is one of the most fertile soils, being a deep mantle of fine sandy top soil underlain with gravels and clays. Much of the Kitsap loam is too steep for cultivation and is in small localized pockets. Where cleared and irrigated they are of good productivity.

The Class III area on Bainbridge Island consists mainly of level and gently sloping expanses of Alderwood loam. It is only a fairly productive glacial soil. Lack of top soil moisture in the growing season, high cost of clearing

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1/ Soil Conservation Service, U.S.D.A. and Washington State Agriculture Experiment Stations cooperating: Washington: Generalized Classification of Land According to Its Capability for Use, 1949. Washington State College Experiment Stations, Pullman, (See map enclosure).

2/ U.S.D.A., Bureau of Chemistry and Soils and Washington State College Experiment Stations: Soil Survey, Kitsap County, Washington, 1939. Washington State College Experiment Stations, Pullman, Washington.

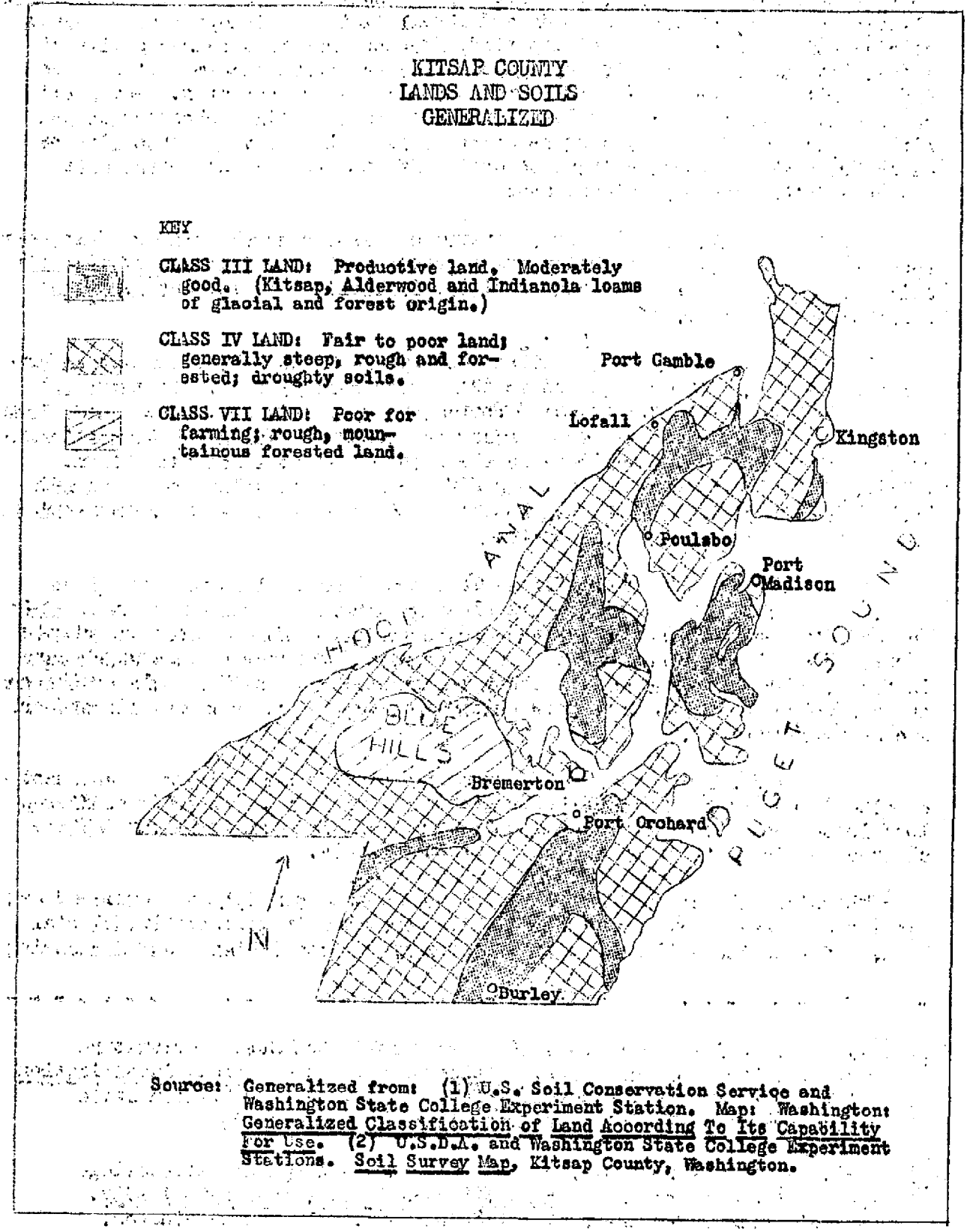

Figure 5. General Quality of the Land in Kitsap County

its coniferous timber (Douglas fir and western hemlock) and cultivating the sloping terrain are main handicaps. By use of sprinkler irrigation, fertilizer and clover rotation, the Alderwood soils on the island have been well developed for cultivation of strawberry and caneberry crops. Where ground water is available for sprinkler use, good yields are procured.

The major portion of Kitsap County is classified as Class IV and VII land which has never been cleared of its forests or logged-over stump land. Much of it is of the soils described above, which are on steep slopes of glacial moraines, and Puget Sound shoreline bluffs. The rougher, forested areas in these poorer lands are the Blue Hills in southern Kitsap County and the bluffs overlooking Hood Canal. The Blue Hills remain forested and are important as a watershed for the defense industries and population concentrated at Bremerton and its vicinity.

Climate

Kitsap County is located in the West Coast Marine Climatic Region of North America--a zone of mild, long, wet winters and cool, short, dry summers--found along the coast from southeastern Alaska to northern California. Climatologists describe this climate as one influenced by the prevailing mild, moist air flowing in from the oceans. In the case of Kitsap County, prevailing westerly winds rising over the Olympic foothills and over the Cascade elevations bring cool, cloudy and wet conditions for about nine months of the year over Puget Sound. During the summer, the land is warm and the winds from off the Washington coast do not drop moisture as frequently as in winter. Summers are fair and warm during the day but cool at night.

Kitsap County, because of its moderately low elevation and partial leeward location to the southeast of the Olympic Mountains, is one of the less rainy areas of western Washington. North Kitsap County is a drier area receiving less than 35 inches of precipitation. It is more in the rain shadow of the Olympics. Air flowing to this region is in a descending, warming and drying state after passing over the lofty range. South Kitsap County is less protected by the coastal ranges and air coming through the Chehalis River gap drops more moisture, generally in excess of 50 inches per year. The Blue Hills southwest of Bremerton also intercept much more moisture. Most of Kitsap County precipitation is in the form of rain. Excessively heavy snows over 6 inches are not common. Bremerton and Keyport weather stations record 36 to 32 inches of rain per year as an average.

Table 6.- Precipitation, Kitsap County

Station and Elevation in Feet	Average Monthly Precipitation (in inches)												Annual Total (inches)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bremerton (162)	5.7	4.4	3.2	2.1	1.6	1.2	1.6	0.8	1.5	2.0	6.0	6.5	36.6
Keyport (35)	5.2	3.7	2.1	1.9	1.4	1.2	0.5	0.7	1.5	2.7	4.1	7.0	32.1

Source: U.S. Weather Bureau, Climatological Data, Washington, Annual Summary 1954.

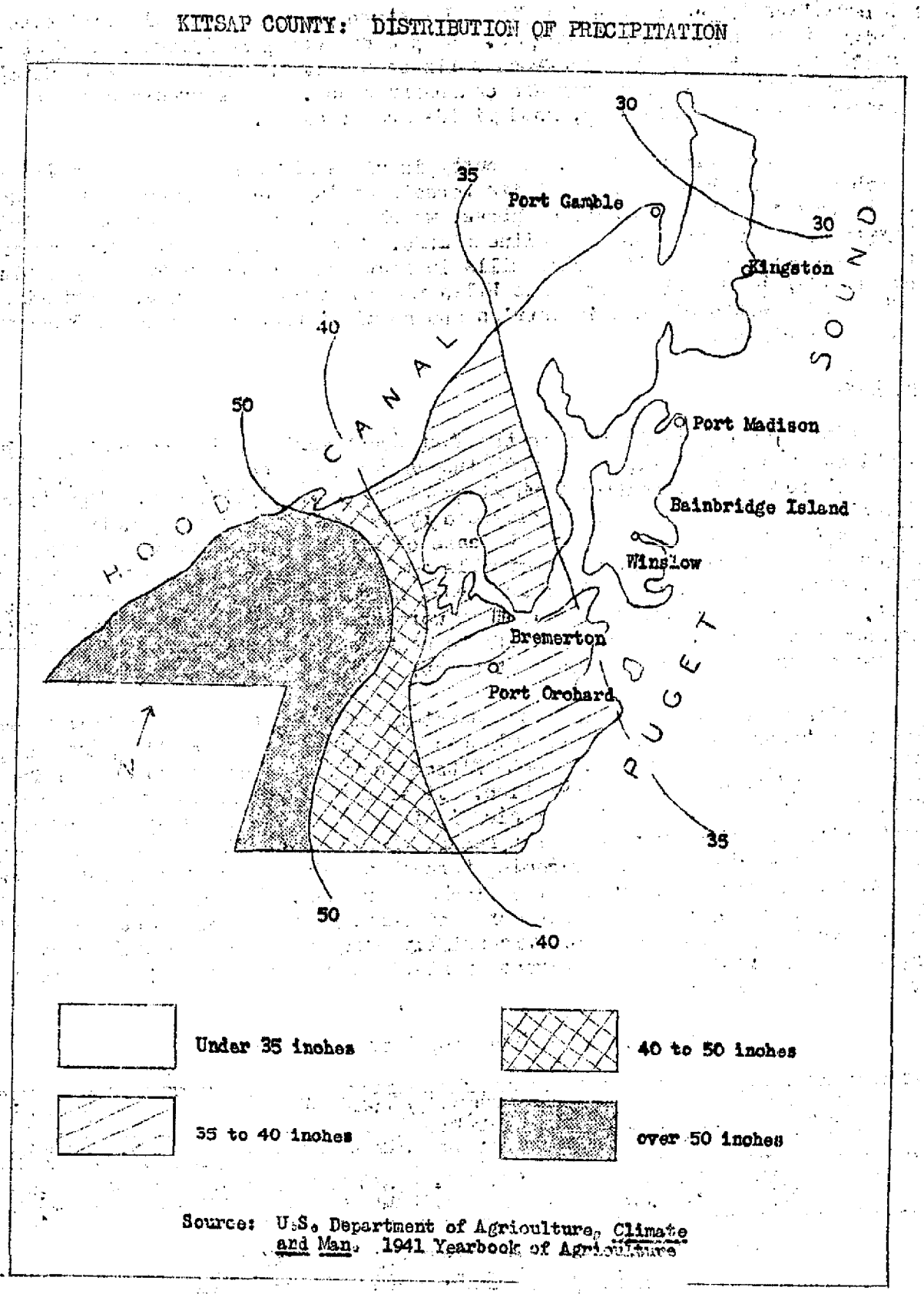

Figure 6. Distribution of Precipitation, Kitsap County

Temperature records at Keyport and Bremerton show the average mildness and lack of extreme in this comfortable marine climate. The prevailing flow of mild air in from the Pacific Ocean to the near west, the warm Chinook winds descending from the Olympics and the surrounding moderating effect of Puget Sound waters and breezes all countribute to mildness. A short record of temperature readings at Bremerton and Keyport near sea level have recorded extreme cold of only 10 degrees and heat waves have never exceeded 100 degrees. Winter daily temperatures are seldom below freezing and average from 35 to 39 degrees in December and January. Summer temperatures, as a daily average, are pleasantly mild and cool, averaging about 60 degrees in July and August. Daily range is great, being about 75 degrees in midday and 55 degrees or less at midnight.

Kitsap County farmers in the shoreside districts and on sloping land with good air drainage, Bainbridge Island for example, can depend on a growing season of about seven months or 210 days. Freeze data indicate that no crop will normally risk killing frosts after mid-April and plants and fruits can expect to survive until almost mid-November before a killing frost ends the growing season or the crop year.

Table 7.- Temperature Extremes, Dates of Killing Frost
Kitsap County

Station	Temperature Extremes Recorded (degrees Fahrenheit)		Killing Frost Average Date	
	Coldest	Hottest	Last in Spring	First in Fall
Bremerton 1/	10	98	April 7	November 4
Keyport	10	98	April 14	November 10

1/ Bremerton's growing season as an average is 211 days between the last killing frost of spring and the first killing frost of autumn.

Source: U.S. Dept. of Agric., Climate and Man, 1941 Yearbook of Agriculture.

Table 8.- Temperatures For Selected Stations, By Months
Kitsap County
(Source: United States Weather Bureau)

Station and Elevation in Feet	Average Temperatures (in degrees Fahrenheit)												Annual Average
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Bremerton (162)	36.6	42.4	42.2	47.2	54.8	56.6	59.8	60.1	58.2	50.8	48.7	39.1	49.0

Forest and Wildlife Resources

The Douglas fir forests of Kitsap County which attracted the first settlers are still an important part of the rural and farm economy. Well cut-over by 1920 by the lumber industry, a new forest of young Douglas fir, western hemlock and alder has regrown and covered a greater part of the county area.

In contrast to neighboring Puget Sound counties which contain large national forests and national parks, most of Kitsap County forest land is privately owned. The State of Washington, through the Commissioner of Public Lands and the State Forestry Division, is the largest public forest land manager, followed by the United States Office of Indian Affairs. State-owned forest land granted to Washington by the United States for public schools and colleges approximates 25,000 acres. 1/ Indian land approximates 5,635 acres in the Port Madison and Port Gamble Reservations.

Farm woodlands, those partially used for pasture and those growing timber and Christmas trees and protected from grazing, make up a total of 22,260 acres. About 880 farms in Kitsap County own woodlands. Their harvest of saw-logs, Christmas trees, cascara bark, salal, huckleberry foliage and wild berries is one of the major sources of farm income.

No exact figures on industrially-owned forest land--those tracts owned by railroads, timber, lumber and paper companies--are available. They are nearly as large, however, as the farmer-owned forest tracts in total acreage.

The extensive woodlands, a number of glacial lakes and numerous Puget Sound inlets make Kitsap County an important recreation area. In addition to the salt water fishing, clam digging and boating there are good conditions for big game hunting and fresh water fishing. 2/ Columbia black-tailed deer, grouse and pheasant find good habitats in the young woodlands and cut-over lands. In the 1955 season 640 deer were bagged within the county. 3/ Kitsap County farm boys and trappers also harvest a catch of several hundred muskrat and a smaller number of mink each winter for the wild fur market in Seattle.

1/ State of Washington, Commissioner of Public Lands. Thirty-Fourth Biennial Report. September 30, 1956. Olympia, Washington.

2/ Washington State Game Department. Game Bulletin, April 1956. N. Washington St., Olympia, Washington.

3/ Washington State Game Department. Game Bulletin, April 1956. N. Washington St., Olympia, Washington.